MASTER OF SCIENCE
IN
APPLIED PHYSICS

TEXTURE ANALYSIS OF HIGH RESOLUTION PANCHROMATIC IMAGERY FOR TERRAIN CLASSIFICATION

Matthew D. Humphrey-Lieutenant Commander, United States Navy
B.A., Virginia Military Institute, 1992
Master of Science in Applied Physics-June 2003
Advisor: Richard C. Olsen, Department of Physics
Second Reader: Alan A. Ross, Navy Tactical Exploitation of National Capabilities Chair

Terrain classification is studied here using the tool of texture analysis of high-spatial resolution panchromatic imagery. This study analyzes the impact and effectiveness of texture analysis on terrain classification within the Elkhorn Slough Estuary and surrounding farmlands within the central California coastal region. Ikonos panchromatic (1 meter) and multispectral (4 meter) imagery data are examined to determine the impact of adding texture analysis to the standard MSI classification approaches. Spectral Angle Mapper and Maximum Likelihood classifiers are used. Overall accuracy rates increased with the addition of the texture processing. The classification accuracy rate rose from 81.0% for the MSI data to 83.9% when the additional texture measures were added. Modest accuracy (55%) was obtained from texture analysis alone. The addition of textural data also enhanced the classifier's ability to discriminate between several different woodland classes contained within the image.

KEYWORDS: Remote Sensing, Multispectral, Ikonos, Texture Filters, Scene Classification, Imagery Interpretation

MOBILE SOURCE DEVELOPMENT FOR SEISMIC SONAR BASED LANDMINE DETECTION

Douglas J. MacLean-Ensign, United States Navy
B.S., Cornell University, 2002
Master of Science in Applied Physics-June 2003
Advisor: Steven R. Baker, Department of Physics
Second Reader: Thomas G. Muir, Department of Physics

Landmines continue to be a threat to both military and civilian communities throughout the world. Current methods of detection, while better than nothing, could certainly be improved. Seismic SONAR is a promising new technology that may help save countless lives.

The goal of this thesis was to advance Seismic SONAR development by introducing a mobile source which could be easily used in practical applications. A small tracked vehicle with dual inertial mass shakers mounted on top was used for the mobile source. The source accurately transmitted the shaker signal into the ground, and its mobility made it a practical choice for field operations. It excited Rayleigh waves, as desired, but also generated undesirable P-waves and was not found to be directional. It proved incapable of finding a target.

Improvements, such as deploying an array of mobile sources and a stronger source, should vastly enhance the performance of such tracked vehicles in seismic SONAR mine detection and should be pursued.

KEYWORDS: Seismic SONAR, Landmine Detection, Mine Detection, Seismic Waves

BARREL WEAR REDUCTION IN RAIL GUNS: THE EFFECTS OF KNOWN AND CONTROLLED RAIL SPACING ON LOW VOLTAGE ELECTRICAL CONTACT AND THE HARD CHROME PLATING OF COPPER-TUNGSTEN AND PURE COPPER RAILS

Cedric J. McNeal-Lieutenant, United States Navy
B.S., Southern University and A&M College, 1997
Master of Science in Applied Physics-June 2003
Advisors: William B. Maier, II, Department of Physics
Richard Harkins, Department of Physics

Barrel wear at the rail-projectile interface continues to hinder the development of a practical rail gun. Previous research at the Naval Postgraduate School tested barrel wear for current densities up to 28,500 kA/cm^2 with selected interface materials at low velocities (<100 m/s). Low voltage electrical contact was not maintained for some experimental shots and non-parallel rails were the suspected cause. In this thesis, a non-contact capacitive sensor was used to determine rail spacing to within $\pm 10mm$, so that the rails will be parallel within small tolerances. Several rails were used in these experiments: 75-25 copper-tungsten, chromium-plated 75-25 Cu-W, and chromium-plated pure copper rails. Improving the control of rail spacing and parallelity did not ensure low-voltage electrical contact for the configurations. The largest damage was observed for chromium-plated copper rails and the least damage occurred for chromium-plated 75-25 Cu-W rails.

KEYWORDS: Rail Gun, Railgun, Low Voltage Electrical Contact, Non-Contact Capacitive Sensor, Hard-chrome Plating

A WATER TUNNEL INVESTIGATION OF A SMALL SCALE ROTOR OPERATING IN THE VORTEX RING STATE

Charles B. Rumsey, Jr.-Major, United States Marine Corps
B.S., Virginia Polytechnic Institute and State University, 1987
Master of Science in Applied Physics-June 2003
Advisors: E. Roberts Wood, Department of Aeronautics and Astronautics
Steven R. Baker, Department of Physics

Motivation to expand the understanding of a helicopter rotor descending into the vortex ring state (VRS) stems from the aircraft mishaps that have plagued the helicopter community. The V-22 has become the most recent victim of encounters with VRS.

The onset of VRS is associated with the collapse of the helical vortex wake in the plane of the rotor. The resulting wake disturbances develop an irregular and aperiodic flow. Rotor blade interaction with the disturbed vortices causes large variations in the blade spanwise aerodynamic load distribution. Harmonic analysis of the loading indicates that higher harmonic content becomes prevalent in this state.

The dynamic flow similarities achieved in a water tunnel are used to explore flow visualization and conduct vibration analysis of a rotor system operating in the VRS. A scaled rotor system was operated in the NPS Aeronautics Department's water tunnel. Sensors were used to gather thrust and vibration power spectrum data when operating in VRS. Experimental results correlate with full scale flight data and show a significant increase in the vibration levels of the even multiples of the blade passage frequency. The relative strength of these higher harmonics can be used as an indicator of impending VRS encounters.

KEYWORDS: Vortex Ring State, Power Settling, VRS, Water Tunnel, Vibration Analysis of VRS, Harmonics of VRS

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RELIABILITY ANALYSIS OF THE 4.5 ROLLER BEARING
Cole Muller-Ensign, United States Navy
B.S., United States Naval Academy, 2002
Master of Science in Applied Sciences-June 2003
Advisor: David H. Olwell, Department of Operations Research
Second Reader: Samuel E. Buttrey, Department of Operations Research

In this thesis, two approaches to analyze the data are presented. The first approach is life data analysis, while the second uses regression. In the life data analysis approach, the time to failure, in engine hours, of 0.0001% of all bearings is estimated to be 42.8 engine hours. In the regression approach, the levels of metallic residue in the oil filter sample are used to determine whether or not a bearing has failed. It was found that the element Vanadium is a key predictor in bearing failure. It was determined that if 0.00544 grams of Vanadium is found in the oil sample, then the bearing is near failure and should be replaced. The discussion of the underlying principles is mainly in the appendices.

KEYWORDS: Data Analysis, Reliability, Regression, CART, Life Data Analysis

VALUE AIDED SATELLITE ALTIMETRY DATA FOR WEAPON PRESETS
Michael D. Perry-Ensign, United States Navy
B.S., Auburn University, 2002
Master of Science in Applied Sciences-June 2003
Advisor: Peter C. Chu, Department of Oceanography
Second Reader: Eric Gottshall, Space and Naval Warfare Systems Command

The purpose of this thesis is to determine the effect that the inclusion of satellite altimeter data has on weapon preset accuracy. GDEM data and MODAS data utilizing four satellite altimeters were used by the Weapon Acoustic Preset Program to determine the suggested presets for a Mk 48 torpedo. The acoustic coverage area generated by the program was used as the metric to compare the two sets of outputs. The assumption was that the MODAS initialized presets were more accurate, and, therefore, the difference between the two sets of presets can be attributed to inaccuracy on the part of the GDEM presets. Output presets were created for two different scenarios, an Anti-Surface Warfare (ASUW) scenario and an Anti-Submarine Warfare (ASW) scenario, and three different depth bands: shallow, mid, and deep. After analyzing the output, it became clear that the GDEM data predicted a weapon effectiveness that was far higher than the effectiveness predicted by the MODAS data. Also, while GDEM predicted a wide range of coverage percentages MODAS predicted a narrow range of coverage percentages.

KEYWORDS: TERMS GDEM, MODAS, Mk 48, Satellite Altimeter, Temperature, Salinity, Sound Speed Profile, Ray Trace, Signal Excess, ASW, ASUW